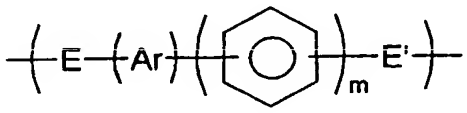
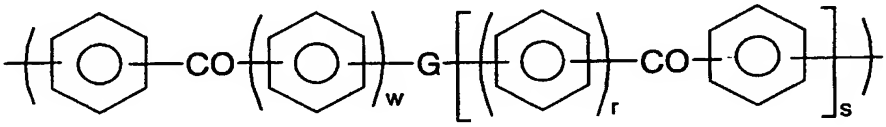
CLAIMS

1. A composite membrane which includes a conductive polymer and a support material for the polymer, said polymer having a moiety of formula



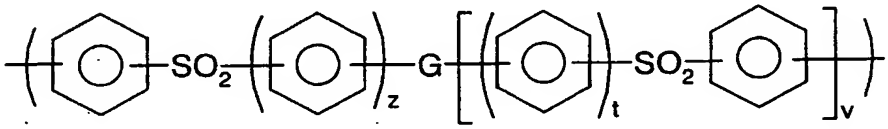
I

and/or a moiety of formula



II

and/or a moiety of formula



III

wherein at least some of the units I, II and/or III are functionalized to provide ion exchange sites; wherein the phenyl moieties in units I, II, and III are independently optionally substituted and optionally cross-linked; and wherein m,r,s,t,v,w and z independently represent zero or a positive integer, E and E' independently represent an oxygen or a sulphur atom or a direct link, G represents an oxygen or sulphur atom, a direct link or a -O-Ph-O- moiety

where Ph represents a phenyl group and Ar is selected from one of the following moieties (i)* and (i) to (x) which is bonded via one or more of its phenyl moieties to adjacent moieties

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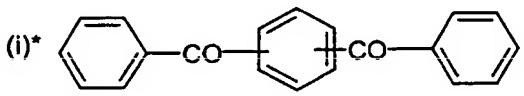

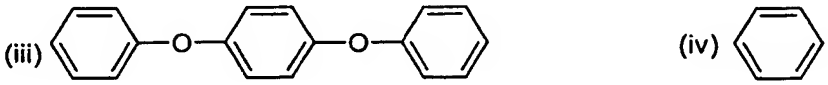

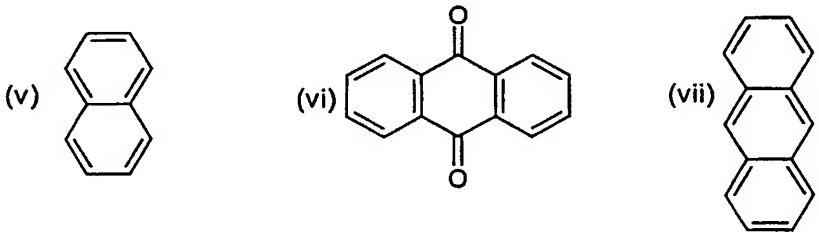

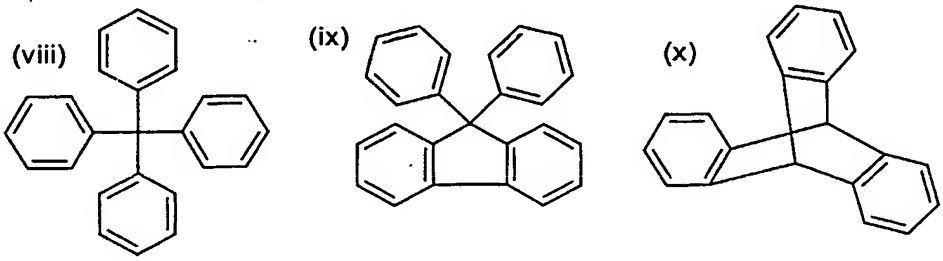

2. A membrane according to claim 1, where said first conductive polymer is sulphonated.

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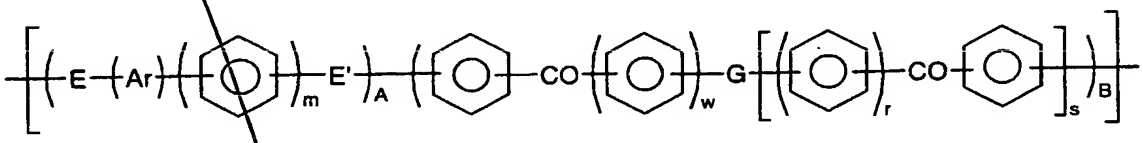
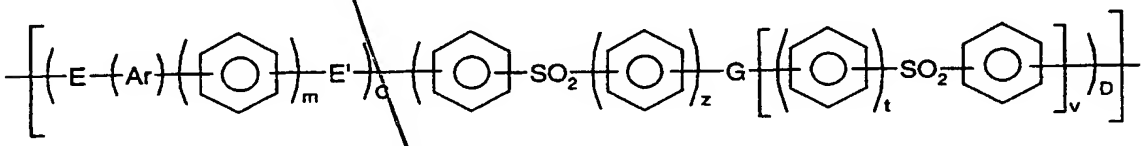
3. A membrane according to claim 1 or claim 2, wherein said first conductive polymer is crystalline.

4. A membrane according to any preceding claim, wherein said polymer is a homopolymer having a repeat unit of general formula



IV

or a homopolymer having a repeat unit of general formula



V

or a random or block copolymer of at least two different units of IV and/or V

wherein A, B, C and D independently represent 0 or 1.

5. A membrane according to any preceding claim, wherein said first conductive polymer includes at least some ketone moieties in the polymeric chain.

6. A membrane according to any preceding claim, wherein said first conductive polymer is a copolymer comprising a first repeat unit which is selected from the following:

(a) a unit of formula IV wherein E and E' represent oxygen atoms, G represents a direct link, Ar represents a

moiety of structure (iv), m and s represent zero, w represents 1 and A and B represent 1;

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(b) a unit of formula IV wherein E represents an oxygen atom, E' represents a direct link, Ar represents a moiety of structure (i), m represents zero, A represents 1, B represents zero;

(c) a unit of formula V wherein E and E' represent oxygen atoms, G represents a direct link, Ar represents a moiety of structure (iv), m and v represent zero, z represents 1 and C and D represent 1;

(d) a unit of formula V wherein E represents an oxygen atom, E' represents a direct link, Ar represents a moiety of structure (ii), m represents 0, C represents 1, D represents 0; or

(e) a unit of formula V wherein E and E' represents an oxygen atom, Ar represents a structure (i), m represents 0, C represents 1, Z represents 1, G represents a direct link, v represents 0 and D represents 1;

and a second repeat unit which is selected from the following:

(f) a unit of formula IV wherein E and E' represent oxygen atoms, G represents a direct link, Ar represents a moiety of structure (iv), m represents 1, w represents 1, s represents zero, A and B represent 1;

(g) a unit of formula IV wherein E represents an oxygen atom, E' is a direct link, G represents a direct link, Ar

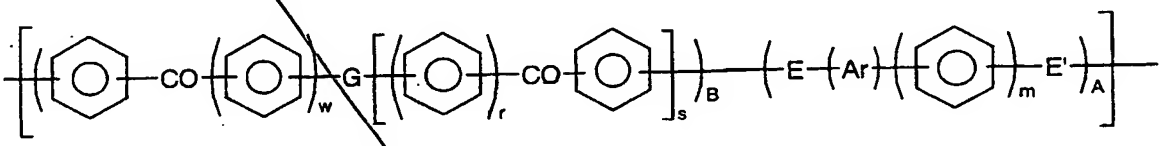
represents a moiety of structure (iv), m and s represent zero, w represent 1, A and B represent 1;

(h) a unit of formula V wherein E and E' represent oxygen atoms, G represents a direct link, Ar represents a moiety of structure (iv), m represents 1, z represents 1, v represents 0, C and D represent 1; and

(i) a unit of formula V wherein E represents an oxygen atom, E' represents a direct link, G represents a direct link, Ar represents a moiety of structure (iv), m and v represent zero, z represents 1, C and D represent 1;

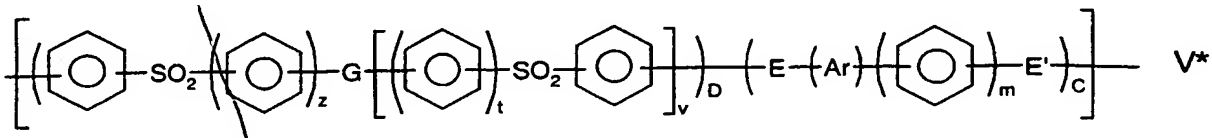
7. A membrane according to claim 6, wherein said first conductive polymer includes a first repeat unit selected from repeat units (b), (d) or (e) in combination with a second repeat unit selected from units (f) or (h).

8. A membrane according to any preceding claim, wherein said first conductive polymer is a homopolymer having a repeat unit of general formula



IV*

or a homopolymer having a repeat unit of general formula



or a random or block copolymer of at least two different units of IV* and/or V* wherein A, B, C and D independently represent 0 or 1.

9. A membrane according to any preceding claim, wherein said first conductive polymer includes a biphenylene moiety.

10. A membrane according to any preceding claim, wherein said first conductive polymer includes a -O-biphenylene-O- moiety.

11. A membrane according to any preceding claim, wherein a film of said conductive polymer is laminated to the support material.

12. A membrane according to any of claims 1 to 10, wherein the support material is porous and said conductive polymer is impregnated in the support material.

13. A membrane according to any preceding claim, wherein said support material comprises a polymer having a moiety of formula I, II and/or III as described in any preceding claim except that the polymer of the support material is either not sulphonated (or otherwise functionalised to provide ion-exchange sites) or is only sulphonated (or otherwise functionalised to provide ion-exchange sites) at or in the region of the surface of the support material.

14. A membrane according to any preceding claim, wherein said support material is selected from the following homopolymers of formula IV as shown in claim 4:

- E and E' represent oxygen atoms, G represents a direct link, Ar represents a moiety of structure (iv), m and s represent zero, w represents 1 and A and B represent 1

- E represents an oxygen atom, E' represents a direct link, Ar represents a moiety of structure (i), m represents zero, A represents 1, B represents zero

- Ar represents a moiety (iv), E and E' represent oxygen atoms, G represents a direct link, m represents 0, w represents 0, s represents 1, r represents 1 and A and B represent 1.

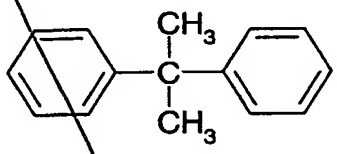
- Ar represents a structure (i)*, E represents an oxygen atom, E' represents a direct link, m represents 0, A represents 1, B represents 0.

- Ar represents moiety (i), E and E' represent oxygen atoms, G represents a direct link, m represents zero, w represents 1, r represents 0, s represents 1 and A and B represent 1

- Ar represent moiety (iv), E represents a sulphur atom, m represents 0, E' represents a direct link and B represents 0;

or is selected from:

- a homopolymer of formula V wherein E represents an oxygen atom, E' represents a direct link, Ar represents a moiety of structure (ii), m represents 0, C represents 1, D represents 0; and is selected from:
- polysulphone for example comprising a homopolymer of formula V wherein E and E' represent oxygen atoms, m represents zero, C and D represent 1, z represents 1, G represents a direct link, v represents zero and Ar represents a moiety of structure:



15. A membrane according to any preceding claim, wherein said first conductive polymer has an equivalent weight (EW) of less than 800g/mol, preferably less than 500 g/mol.

16. A conductive polymer and a support material for the polymer, wherein said polymer includes: polyaryletherketone and/or polyarylethersulphone units; and units of formula $-O-Ph_n-O-$ (XX) wherein Ph represents a phenyl group and n represents an integer of 2 or greater and wherein Ph groups of units (XX) are sulphonated.

17. A fuel cell or electroylser incorporating a composite membrane according to any preceding claim.

18. A method of making a composite membrane according to any of claims 1 to 16, the method comprising causing a conductive polymer as described in any of claims 1 to 16

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to be associated with a support material as described in any of claims 1 to 16.

19. A method according to claim 18, which includes impregnating porous support material with conductive polymer.

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20. A method according to claim 18 or claim 19, wherein a first solvent formulation comprises a polar aprotic solvent in which a conductive polymer is provided and said support material is a material (e.g. a polyetheretherketone fabric or a polyetherketone microporous membrane) which is not soluble in said polar aprotic solvent, wherein the method includes a step of contacting said support material with said first solvent formulation.

21. A method according to claim 18 or claim 19, wherein said support material is a fabric and the method includes a step of contacting the fabric with a first solvent formulation comprising a first solvent and said conductive polymer, wherein said first solvent and said support material are selected so that the first solvent solubilizes a surface of the support material.

22. A method according to claim 21, wherein said first solvent is capable of functionalising said support material to provide ion-exchange sites on the surface thereof.

23. A method according to claim 22, wherein said first solvent includes less than 99% acid.

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24. A method according to claim 18 or claim 19, the method including:

contacting said support material with a solvent formulation comprising a first solvent which solubilizes the support material; and

contacting the support material with a second solvent to cause phase inversion and render said support material porous.

25. A method according to claim 24, wherein said conductive polymer is provided in a third solvent and caused to penetrate pores in the support material.